Numerical

3.1 A force of 20 N moves a body with an acceleration of 2 ms^{-2}. What is its mass?

(10kg)

Solution: Force = F = 20 N

Acceleration = a = 2 ms^{-2}

Mass = m = **?**

F = ma

Or $$m = \frac{F}{a}$$

$$m = \frac{20}{2} = 10 \text{ kg}$$

3.2 The weight of a body is 147 N. What is its mass? (Take the value of g as 10 ms^{-2})

(14.7 kg)

Solution: Weight = w = 147 N

Acceleration due to gravity = g = 10 ms^{-2}

Mass = m = **?**

w = mg

or $$m = \frac{w}{g}$$

$$m = \frac{147}{10}$$

$m = 14.7\ kg$

3.3 How much force is needed to prevent a body of mass 10 kg from falling?

(100 N)

Solution: Mass = m = 50 kg

Acceleration = $a = g = 10\ ms^{-2}$

Force = F = **?**

$F = m\ a$

$F = 10 \times 10$

$F = 100\ N$

3.4 Find the acceleration produced by a force of 100 N in a mass of 50 kg.

($2\ ms^{-2}$)

Solution: Force = F = 100 N

Mass = m = 50 kg

Acceleration = a = **?**

$F = m\ a$

Or $a = \frac{F}{m}$

$a = \frac{100}{50}$

$a = 2\ ms^{-2}$

3.5 A body has weight 20 N. How much force is required to move it vertically upward with an acceleration of 2 ms $^{-2}$?

(24 N)

Solution: Weight = w = 20 N

Acceleration = a = 2 ms $^{-2}$

Vertically upward force (Tension) = T = **?**

$F_{net} = T - w$

Or $ma = T - mg$

Or $ma + mg = T$

Or $T = m(a + g)$ .....(i)

Now, $m = \frac{w}{g}$

$m = \frac{20}{10} = 2$ kg

Putting the value of m in Eq.(i), we get

$T = 2(2 + 10)$

$= 2(12)$

$T = 24$ N

3.6 Two masses 52 kg and 48 kg are attached to the ends of a string that passes over a frictionless pulley. Find the tension in the string and acceleration in the bodies when both the masses are moving vertically.

(500 N, 0.4 ms $^{-2}$)

Solution: $m_1 = 52$ kg and $m_2 = 48$ kg

(i) Tension T = ?

(ii) Acceleration a = ?

(i) $T = \frac{2m_1m_2}{m_1+m_2} g$

$T = \frac{2 \times 52 \times 48}{52 + 48} \times 10$

$T = \frac{49920}{100}$

$T = 499.20 \approx 500$ N

(ii) $a = \frac{m_1 \quad m_2}{m_1+m_2} g$

$a = \frac{52 - 48}{52 + 48} \times 10$

$a = \frac{4}{100} \times 10$

$a = 0.4\ ms^{-2}$

3.7 Two masses 26 kg and 24 kg are attached to the ends of a string which passes over a frictionless pulley. 26 kg is lying over a smooth horizontal table. 24 N mass is moving vertically downward. Find the tension in the string and the acceleration in the bodies.

(125 N, 4.8 ms $^{-2}$)

Solution: : $m_1 = 24$ kg and $m_2 = 26$ kg

(i) Tension $T = ?$

(ii) Acceleration $a = ?$

(i) $T = \frac{m_1m_2}{m_1+m_2} g$

$T = \frac{24 \times 26}{24 + 26} \times 10$

$T = \frac{6240}{50}$

$$T = 124.8 \approx 125\ N$$

(ii) $$a = \frac{m_1}{m_1 + m_2} g$$

$$a = \frac{24}{24 + 26} \times 10$$

$$a = \frac{24}{50} \times 10$$

$$a = 4.8\ ms^{-2}$$

3.8 How much time is required to change 22 Ns momentum by a force of 20 N?

(1.1s)

Solution: Change in momentum = $P_f - P_i = 22$ Ns

Force = F = 20 N

Time = t = **?**

$$F = \frac{P_f \quad P_i}{t}$$

$$t = \frac{P_f \quad P_i}{F}$$

$$t = \frac{22}{20} = 1.1\ S$$

3.9 How much is the force of friction between a wooden block of mass 5 kg and the horizontal marble floor? The coefficient of friction between wood and the marble is 0.6.

(30 N)

Solution: Mass = m = 5 kg

Coefficient of friction = $\mu = 0.6$

Force of friction = F_S = **?**

$F_S = \mu R$ (where R = mg)

$F_S = \mu mg$

$F_S = 0.6 \times 5 \times 10 = 30$ N

3.10 How much centripetal force is needed to make a body of mass 0.5 kg to move in a circle of radius 50 cm with a speed 3 ms^{-1}?

(9 N)

Solution: Mass = m = 0.5 kg

Radius of the circle = r = 50 cm = $\frac{50}{100}$ = 0.5 m

Speed = v = 3 ms^{-1}

Centripetal force = F_c = **?**

$$F_c = \frac{mv^2}{r}$$

$$F_c = \frac{0.5 \times 3^2}{0.5}$$

$$F_c = \frac{0.5 \times 9}{0.5} = \frac{4.5}{0.5} = 9\ N$$